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Collaborative Project

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D3.4 Procedures and guidelines for Quality Assurance

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Executive summary

Safety and Quality are key in aviation. There are many procedures and standards that have to be met by the aviation fuel in itself as well as by the operations involved in handling the fuel. Most of these are laid down in the well-known fuel quality standards (ASTM, DefStan) and the (airport) operations standards (JIG/EI/ATA).

Since bio jet fuel in the end is similar to conventional jet fuel, except that the source is different, the same standards apply when it comes to (health &) safety.

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Abbreviations

A4A = Airlines for America

API = American Petroleum Institute

ASTM = American Society for Testing and Materials

AFQRJOS = Aviation Fuel Quality Requirements for Jointly Operated Systems

Defstan = Defence Standard

EI = Energy Institute

HEFA = Hydro-treated Esters and Fatty Acids

IATA = International Air Transport Association

ICAO = International Civil Aviation Organization

JIG = Joint Inspection Group

SAE = Society of Automative Engineers

SJF = Sustainable Jet Fuel

Definitions

ASTM: originally known as the American Society for Testing and Materials, this international standards organization develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems, and services. ASTM International works with aircraft and engine manufacturers, government authorities and fuel suppliers to set the standards for aviation fuels such as the required characteristics for jet fuel.

ASTM D1655: Standard Specification for Aviation Turbine Fuel. This specification defines the minimum property requirements for Jet A and Jet A-1 aviation turbine fuel and lists acceptable additives for use in civil operated engines and aircrafts. Specification D1655 is directed at civil applications, and maintained as such, but may be adopted for military, government or other specialized uses.

ASTM D7566: Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons. The main part of this standard contains the specifications for synthetic jet fuel blended with Jet A or Jet A-1. Once certified, the blended jet fuel batch is automatically recertified to ASTM D1655 and considered a drop-in fuel batch. Blending is only allowed after the neat synthetic jet fuel batch is certified to the applicable Annex of D7566. Each Annex belongs to a specific synthetic jet fuel production pathway; a total of five pathways are currently certified.

DefStan 91-91: "Defence Standard 91-91", the Aviation Turbine Fuel (Kerosene Type, Jet A-1) standard developed by the UK Aviation Fuels Committee (AFC) on behalf of the Ministry of Defence (MOD). Developed for use in the UK, but today also used in many European countries.

HEFA: Hydro-treated esters and fatty esters / the technology to treat triglycerides with hydrogen under increased pressure and temperature to convert them into hydrocarbons.

JIG: Joint Inspection Group. Established by numerous oil companies that share jet fuel infrastructure to and at airports, and developed a set of standard/guidelines which govern the operation of the shared fuel infrastructure.

EI 1530: Quality assurance requirements for the manufacture, storage and distribution of aviation fuels to airports. EI/JIG 1530 provides a standard for maintaining aviation fuel quality, from production through (sometimes complex) distribution systems to airports. It provides mandatory provisions and good practice recommendations for the design/functional requirements of facilities, and operational procedures.

AFQRJOS: The Aviation Fuel Quality Requirements for Jointly Operated Systems are the agreed specification requirements for jet fuel supplied into jointly operated locations. It comprises the most stringent specifications of both ASTM D1655 and DefStan 91-91.

1 Introduction

Safety and Quality are key in aviation. There are many procedures and standards that have to be met by the aviation fuel in itself as well as by the operations involved in handling the fuel. Most of these are laid down in the well-known fuel quality standards (ASTM, DefStan) and the (airport) operations standards (JIG/EI/ATA).

This report provides information on the fuel quality and fuel handling standards for (bio) jet fuel.

2 Procedures and Guidelines for SJF Fuel Quality Assurance

Aviation fuel and aviation fuel handling have to meet various requirements. Most of these requirements are laid down in standards and specifications that are made by organizations like ASTM, EI, JIG, A4A, etc. Compared to other fuel products, the specifications for jet fuel and jet fuel handling are much more controlled since a small deviation in property of the product can affect engine performance and thereby the safety of a flight. Therefore, control systems are in place that monitor fuel quality and fuel handling throughout the chain.

The most common standards (for Europe/US) in which **aviation fuel quality requirements** are laid down are:

- ASTM D1655: Standard Specification for Aviation Turbine Fuels
- ASTM D7566: Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons
- DEFSTAN 91-91: Turbine Fuel, Aviation Kerosine Type, Jet A1

One of the best known standardization organizations is ASTM, in which subcommittee D02.J is responsible for aviation fuels standards, e.g. D1655 for Jet A and Jet A-1, and D7566 for Jet A and Jet A-1 containing synthesized hydrocarbons. These ASTM standards are well respected within the aviation industry and used globally.

Sustainable jet fuel may only be used in turbine engines after being certified to D7566 specifications for the neat sustainable jet, blended with regular (D1655 certified) Jet A/A-1 and again certified to D7566 specifications for the blend. After the blend certification, the blend is automatically recertified to D1655. The blend then meets the same specifications as regular Jet A/A-1 should meet, and from then on can be considered a drop-in jet fuel that can be handled and used in the same way as regular Jet A/A-1.
The D7566 standard consists of two parts. The Annexes contain the specifications for neat sustainable jet fuel, in which every Annex is applicable to a specific production pathway. Currently, there are five SJF production pathways certified. After blending the SJF with regular Jet A/A-1, the blend is certified according to the general part of D7566 and with this step automatically recertified to ASTM D1655. The figure below shows a schematic overview of this certification process.

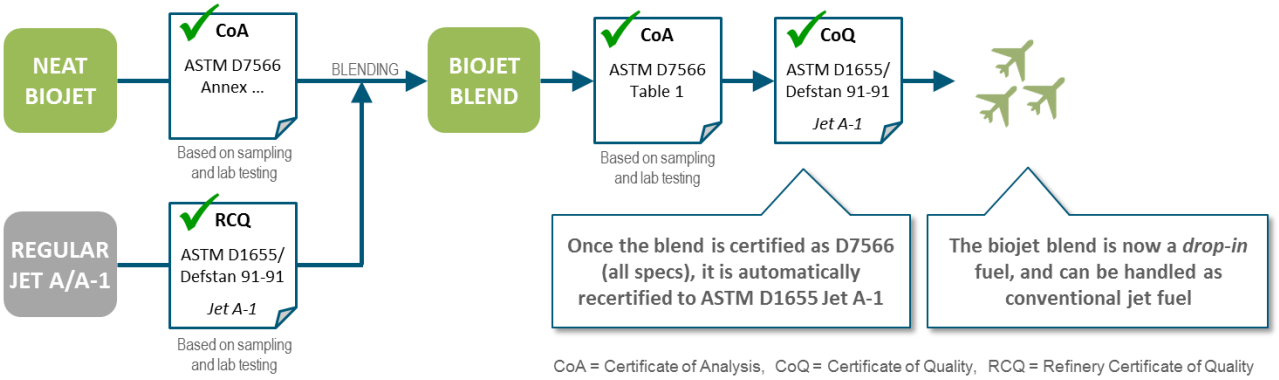

Figure 1. Schematic overview of the sustainable jet fuel certification process.

Although globally the ASTM D1655 standard is widely accepted and used, it is not the only standard for Jet A-1. The by the United Kingdom's Ministry of Defence developed Defence Standard (DefStan) 91-91 for Jet A-1 is more common in Europe. Both standards are almost identical, they only differ on some parameters, e.g. conductivity and traceability requirements. Both ASTM D1655 and DefStan 91-91 refer to the ASTM D7566 standard when it comes to synthesized hydrocarbons, hence both standards allow sustainable jet fuel to the same extend.

For the ITAKA deliveries, CoA's have been issued for the neat HEFA and the blended fuel. (uploaded as part of a separate ITAKA deliverable report). Fuel Quality assurance have been included in the Operating procedures that have been prepared for the ITAKA deliveries (Schiphol and Oslo) and were included in a separate ITAKA deliverable report.

3 Procedures and Guidelines for (SJF) Fuel Handling

The most common standards (for Europe/US) in which **aviation fuel handling requirements** are laid down are:

- JIG Sections 1 to 4 Guidelines for Aviation Fuel Quality Control and Operating:
- EI 1530 Quality assurance requirements for the manufacture, storage and distribution of aviation fuels to airport
- IATA Fuel Quality Pool: Control of Fuel Quality & Fueling Safety Standards Procedures for Joint Into-Plane Fueling Services
- ICAO Doc 9977, AN/489: Manual on Civil Aviation Jet Fuel Supply
- API 1543 Documentation, Monitoring and Laboratory Testing of Aviation Fuel During Shipment from Refinery to Airport
- API 1540: Design, construction, operation and maintenance of aviation
- fuelling facilities (Model code of safe practice Part 7)
- EI/HM 50: Guideline for the cleaning of tanks and lines for marine tank vessels carrying petroleum and refined products.
- A4A ATA 103: Standards for Jet Fuel Quality Control at Airports
- API 1595: Design, Construction, Operation, Maintenance, and Inspection of Aviation Pre-Airfield Storage Terminals
- SAE Aerospace SAE- AS 6401 Storage, Handling and Distribution of Jet Fuels at Airports

JIG/EI have been most relevant for the deliveries within ITAKA.

JIG/EI

At large airports, many aviation fuel suppliers share the use of fuel storage tanks and fuelling systems, thereby preventing unnecessary infrastructure duplication and additional costs. The Joint Inspection Group (JIG) was established by oil companies to develop a set of standards that govern the operation of the shared fuel infrastructure on airports where the JIG companies operate. However, usage of the JIG guidelines is not limited to jointly operated locations, any operator providing aviation fuel infrastructure may use the guidelines.

Today, most European airports operate by these JIG guidelines. The guidelines are not only applicable to the airport's operations (JIG 1 and 2), but also cover the jet fuel supply chain (JIG 3). The Energy Institute (EI) and JIG jointly extended the JIG 3 guideline to cover also operations further upstream, including refineries. This has become the EI 1530 guideline. The picture below shows which pieces of the supply chain are covered by which standards.

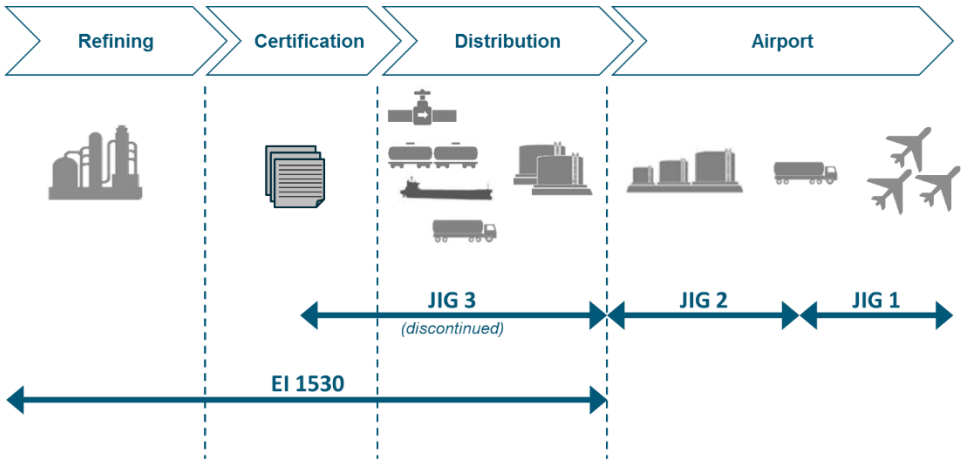

Figure 2. Overview of JIG guidelines coverage in aviation fuel supply chains.

Part of the JIG guidelines is the Aviation Fuel Quality Requirements for Jointly Operated Systems (AFQRJOS), defining the fuel quality requirements for supply into jointly operated fuelling systems. It embodies the most stringent requirements of both ASTM D1655 and DefStan 91-91. Since 2012, both JIG and EI 1530, hence also the AFQRJOS, follow ASTM and DefStan regarding allowance of synthetic components to be blended with Jet A-1 for up to 50%. In other words, JIG allows SJF to be used in existing jet fuel infrastructure to and at airports.

MSDS

In addition to the above, manufacturers and distributors of jet fuel (and actually of any hazardous fuel or chemical product) are required to issue a Material Safety Data Sheet (MSDS) with the shipment of the product.

A Material Safety Data Sheet (MSDS) gives detailed information about the nature of a chemical, such as physical and chemical properties, health, safety, fire, and environmental hazards of a chemical product. It classifies a product into a hazardous category, it describes how to handle the product in a safe way and what to do in case there might be a spill.

- Chemical Identity: Name of the product.
- Manufacturer's Information (Name, address, etcetera)
- Hazardous Ingredients/Identity Information: List of hazardous chemicals.
- Physical/Chemical Characteristics, like Boiling point, vapor pressure and density, melting point, evaporation rate, etc.
- Fire and Explosion Hazard Data: Flash point, flammability limits, ways to extinguish, special firefighting procedures, unusual fire and explosion hazards.
- Reactivity Data: How certain materials react with others when mixed or stored together.
- Health Hazard Data: Health effects (acute= immediate; chronic= long-term), ways the hazard can enter the body (lungs, skin or mouth), symptoms of exposure, emergency and first aid procedures.

- Precautions of Safe Handling and Use: What to do in case of a spill or leak, how to dispose of waste safely, how to handle and store materials in a safe manner.
- Control Measures: Eg. Ventilation (local, general, etc.), type of respirator/filter to use, protective gloves, clothing and equipment, etc.

Conclusions

Safety and product quality is key in aviation. There are many procedures and standards that have to be met by the aviation fuel in itself as well as by the operations involved in handling the fuel. Most of these are laid down in the well-known fuel quality standards (ASTM, DefStan) and the (airport) operations standards (JIG/EI/ATA) and also hold for SJF deliveries.

Within ITAKA, fuel quality assurance and fuel handling have been included in the operating procedures that have been developed for the SJF deliveries at Schiphol and Oslo.